(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
8 April 2004 (08.04.2004)

PCT

(10) International Publication Number
WO 2004/030015 A2

(51) International Patent Classification[7]: H01J 37/00

(21) International Application Number: PCT/IB2003/005249

(22) International Filing Date: 29 September 2003 (29.09.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10/259,380 30 September 2002 (30.09.2002) US

(71) Applicant: TOKYO ELECTRON LIMITED [JP/JP]; TBS Broadcast Center, 3-6, Akasaka 5-chome, Minato-ku, Tokyo 107-8481 (JP).

(72) Inventors: SAIGUSA, Hidehito; c/o Tokyo Electron AT Limited, 2381-1, Kitagejo, Fujii-cho, Nirasaki-shi, Yamanashi 407-8511 (JP). TAKASE, Taira; c/o Tokyo Electron AT Limited, 2381-1, Kitagejo, Fujii-cho, Nirasaki-shi, Yamanashi 407-8511 (JP). MITSUHASHI, Kouji; c/o Tokyo Electron AT Limited, 2381-1, Kitagejo, Fujii-cho, Nirasaki-shi, Yamanashi 407-8511 (JP). NAKAYAMA, Hiroyuki; c/o Tokyo Electron AT Limited, 2381-1, Kitagejo, Fujii-cho, Nirasaki-shi, Yamanashi 407-8511 (JP).

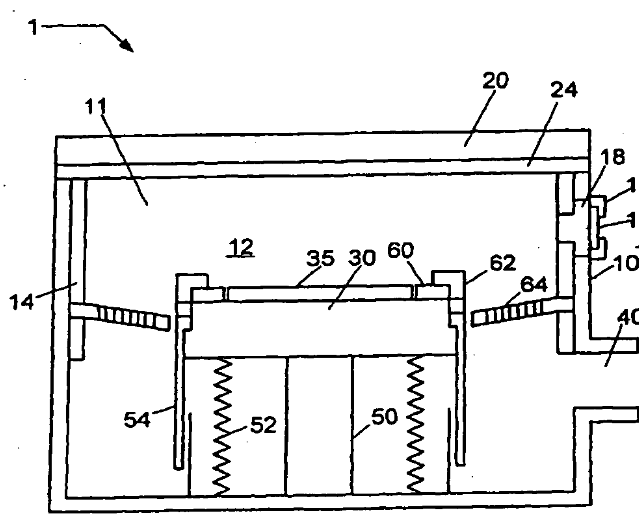
(74) Agent: SUZUYE, Takehiko; c/o Suzuye & Suzuye, 7-2, Kasumigaseki 3-chome, Chiyoda-ku, Tokyo 100-0013 (JP).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: METHOD AND APPARATUS FOR AN IMPROVED BAFFLE PLATE IN A PLASMA PROCESSING SYSTEM



WO 2004/030015 A2

(57) Abstract: The present invention presents an improved baffle plate for a plasma processing system, wherein the design and fabrication of the baffle plate advantageously provides for a uniform processing plasma in the process space with substantially minimal erosion of the baffle plate.

Published:
— *without international search report and to be republished upon receipt of that report*

METHOD AND APPARATUS FOR AN IMPROVED BAFFLE PLATE IN A PLASMA PROCESSING SYSTEM

Cross-reference to Related Applications

[0001] This application is related to co-pending United States patent application serial no. 10/XXX,XXX, entitled "Method and apparatus for an improved upper electrode plate with deposition shield in a plasma processing system", Attorney docket no. 226272US6YA, filed on even date herewith; co-pending United States patent application serial no. 10/XXX,XXX, entitled "Method and apparatus for an improved baffle plate in a plasma processing system", Attorney docket no. 226274US6YA, filed on even date herewith; co-pending United States patent application serial no. 10/XXX,XXX, entitled "Method and apparatus for an improved upper electrode plate in a plasma processing system", Attorney docket no. 225277US6YA, filed on even date herewith; co-pending United States patent application serial no. 10/XXX,XXX, entitled "Method and apparatus for an improved deposition shield in a plasma processing system", Attorney docket no. 226275US6YA, filed on even date herewith; co-pending United States patent application serial no. 10/XXX,XXX, entitled "Method and apparatus for an improved optical window deposition shield in a plasma processing system", Attorney docket no. 226276US6YA, filed on even date herewith; and co-pending United States patent application serial no. 10/XXX,XXX, entitled "Method and apparatus for an improved bellows shield in a plasma processing system", Attorney docket no. 226277US6YA, filed on even date herewith. The entire contents of all of those applications are herein incorporated by reference in their entirety.

Field of the Invention

[0002] The present invention relates to an improved component for a plasma processing system and, more particularly, to a baffle plate employed in a plasma processing system surrounding a substrate holder.

Background of the Invention

[0003] The fabrication of integrated circuits (IC) in the semiconductor industry typically employs plasma to create and assist surface chemistry within a plasma reactor necessary to remove material from and deposit material to a substrate. In general, plasma is formed within the plasma reactor under vacuum conditions by heating electrons to energies sufficient to sustain ionizing collisions with a supplied process gas. Moreover, the heated electrons can have energy sufficient to sustain dissociative collisions and, therefore, a specific set of gases under predetermined conditions (e.g., chamber pressure, gas flow rate, etc.) are chosen to produce a population of charged species and chemically reactive species suitable to the particular process being performed within the chamber (e.g., etching processes where materials are removed from the substrate or deposition processes where materials are added to the substrate).

[0004] Although the formation of a population of charged species (ions, etc.) and chemically reactive species is necessary for performing the function of the plasma processing system (i.e. material etch, material deposition, etc.) at the substrate surface, other component surfaces on the interior of the processing chamber are exposed to the physically and chemically active plasma and, in time, can erode. The erosion of exposed components in the plasma processing system can lead to a gradual degradation of the plasma processing performance and ultimately to complete failure of the system.

[0005] In order to minimize the damage sustained by exposure to the processing plasma, components of the plasma processing system, known to sustain exposure to the processing plasma, are coated with a protective barrier. For example, components fabricated from aluminum can be anodized to produce a surface layer of aluminum oxide, which is more resistant to the plasma. In another example, a consumable or replaceable component, such as one fabricated from silicon, quartz, alumina, carbon, or silicon carbide, can be inserted within the processing chamber to protect the surfaces of more valuable components that would impose greater costs during frequent replacement. Furthermore, it is desirable to select surface materials that minimize the introduction of unwanted contaminants, impurities, etc. to the processing plasma and possibly to the devices formed on the substrate.

[0006] In both cases, the inevitable failure of the protective coating, either due to the integrity of the protective barrier or the integrity of the fabrication of the protective barrier, and the consumable nature of the replaceable components demands frequent maintenance of the plasma processing system. This frequent maintenance can produce costs associated with plasma processing down-time and new plasma processing chamber components, which can be excessive.

Summary of the Invention

[0007] The present invention provides an improved baffle plate for a plasma processing system, wherein the design and fabrication of the baffle plate advantageously addresses the above-identified shortcomings.

[0008] It is an object of the present invention to provide a baffle plate comprising a canted ring having an upper surface, a lower surface, an inner radial edge, and an outer radial edge. The upper surface can further comprise a first mating surface proximate the outer radial edge. The lower surface can further comprise a second mating surface proximate the outer radial edge. The baffle plate can further comprise at least one passageway coupled to the upper surface and to the lower surface, and configured to permit the flow of gas therethrough, wherein the at least one passageway can comprise an inner passageway surface.

[0009] It is a further object of the present invention that the exposed surface of the baffle plate comprises the upper surface of the baffle plate excluding the first mating surface; the lower surface of the baffle plate excluding the second mating surface; the inner edge surface; and the inner passageway surface contiguous with the upper surface and the lower surface.

[0010] The present invention further provides a method of producing the baffle plate in the plasma processing system comprising the steps: fabricating the baffle plate; anodizing the baffle plate to form a surface anodization layer on the baffle plate; machining exposed surfaces on the baffle plate to remove the surface anodization layer; and forming a protective barrier on the exposed surfaces.

[0011] The present invention provides another method of producing the baffle plate in the plasma processing system comprising the steps: fabricating the baffle plate; masking exposed surfaces on the baffle plate to prevent formation of a surface anodization layer; anodizing the baffle plate to form the surface anodization layer on

the baffle plate; unmasking the exposed surfaces; and forming a protective barrier on the exposed surfaces.

[0012] The present invention provides another method of producing the baffle plate in the plasma processing system comprising the steps: fabricating the baffle plate; and forming a protective barrier on a plurality of exposed surfaces.

[0013] The present invention may also include a process of combining machining and masking to prepare the exposed surfaces to receive the protective barrier, and then forming the protective barrier on the exposed surfaces. For example, two of the exposed surfaces can be masked prior to anodizing, and two of the surfaces can be machined after anodizing to create four exposed surfaces on which the protective barrier can be formed.

[0014] Any of the above methods may also optionally include machining anodized (or otherwise coated) surfaces that are not exposed surfaces (e.g., to obtain a bare metal connection where the machined surface will mate with another part).

Brief Description of the Drawings

[0015] These and other advantages of the invention will become more apparent and more readily appreciated from the following detailed description of the exemplary embodiments of the invention taken in conjunction with the accompanying drawings, where:

[0016] FIG. 1 shows a simplified block diagram of a plasma processing system comprising a baffle plate according to an embodiment of the present invention;

[0017] FIG. 2 shows a plan view of a baffle plate for a plasma processing system according to an embodiment of the present invention;

[0018] FIG. 3 shows a cross sectional view of a baffle plate for a plasma processing system according to an embodiment of the present invention;

[0019] FIG. 4 shows an expanded cross sectional view of one passageway formed within a baffle plate for a plasma processing system according to an embodiment of the present invention;

[0020] FIG. 5 shows an expanded cross sectional view of a baffle plate for a plasma processing system according to an embodiment of the present invention;

[0021] FIG. 6 presents an expanded view of an outer radial edge of a baffle plate for a plasma processing system according to an embodiment of the present invention;

[0022] FIG. 7 presents a method of producing a baffle plate for a plasma processing system according to an embodiment of the present invention;

[0023] FIG. 8 presents a method of producing a baffle plate for a plasma processing system according to another embodiment of the present invention; and

[0024] FIG. 9 presents a method of producing a baffle plate for a plasma processing system according to another embodiment of the present invention.

Detailed Description of an Embodiment

[0025] The present invention provides an improved baffle plate for a plasma processing system, wherein the design and fabrication of the baffle plate advantageously alleviates the above-identified shortcomings.

[0026] According to an embodiment of the present invention, a plasma processing system 1 is depicted in FIG. 1 comprising a plasma processing chamber 10, an upper assembly 20, an electrode plate 24, a substrate holder 30 for supporting a substrate 35, and a pumping duct 40 coupled to a vacuum pump (not shown) for providing a reduced pressure atmosphere 11 in plasma processing chamber 10. Plasma processing chamber 10 can facilitate the formation of a processing plasma in process space 12 adjacent substrate 35. The plasma processing system 1 can be configured to process 200 mm substrates, 300 mm substrates, or larger.

[0027] In the illustrated embodiment, upper assembly 20 can comprise at least one of a cover, a gas injection assembly, and an upper electrode impedance match network. For example, the electrode plate 24 can be coupled to an RF source, and facilitate an upper electrode for the plasma processing system 1. In another alternate embodiment, the upper assembly 20 comprises a cover and an electrode plate 24, wherein the electrode plate 24 is maintained at an electrical potential equivalent to that of the plasma processing chamber 10. For example, the plasma processing chamber 10, the upper assembly 20, and the electrode plate 24 can be electrically connected to ground potential, and facilitate an upper electrode for the plasma processing system 1.

[0028] Plasma processing chamber 10 can, for example, further comprise a deposition shield 14 for protecting the plasma processing chamber 10 from the processing plasma in the process space 12, and an optical viewport 16. Optical viewport 16 can comprise an optical window 17 coupled to the backside of an optical window deposition shield 18, and an optical window flange 19 can be configured to couple optical window 17 to the optical window deposition shield 18. Sealing members, such as O-rings, can be provided between the optical window flange 19 and the optical window 17, between the optical window 17 and the optical window deposition shield 18, and between the optical window deposition shield 18 and the plasma processing chamber 10. Optical viewport 16 can, for example, permit monitoring of optical emission from the processing plasma in process space 12.

[0029] Substrate holder 30 can, for example, further comprise a vertical translational device 50 surrounded by a bellows 52 coupled to the substrate holder 30 and the plasma processing chamber 10, and configured to seal the vertical translational device 50 from the reduced pressure atmosphere 11 in plasma processing chamber 10. Additionally, a bellows shield 54 can, for example, be coupled to the substrate holder 30 and configured to protect the bellows 52 from the processing plasma. Substrate holder 10 can, for example, further be coupled to at least one of a focus ring 60, and a shield ring 62. Furthermore, a baffle plate 64 can extend about a periphery of the substrate holder 30.

[0030] Substrate 35 can be, for example, transferred into and out of plasma processing chamber 10 through a slot valve (not shown) and chamber feed-through (not shown) via robotic substrate transfer system where it is received by substrate lift pins (not shown) housed within substrate holder 30 and mechanically translated by devices housed therein. Once substrate 35 is received from substrate transfer system, it is lowered to an upper surface of substrate holder 30.

[0031] Substrate 35 can be, for example, affixed to the substrate holder 30 via an electrostatic clamping system. Furthermore, substrate holder 30 can, for example, further include a cooling system including a re-circulating coolant flow that receives heat from substrate holder 30 and transfers heat to a heat exchanger system (not shown), or when heating, transfers heat from the heat exchanger system. Moreover, gas can, for example, be delivered to the back-side of substrate 35 via a backside gas system to improve the gas-gap thermal conductance between substrate 35 and substrate holder 30. Such a system can be utilized when temperature control of the

substrate is required at elevated or reduced temperatures. In other embodiments, heating elements, such as resistive heating elements, or thermo-electric heaters/coolers can be included.

[0032] In the illustrated embodiment, shown in FIG. 1, substrate holder 30 can comprise an electrode through which RF power is coupled to the processing plasma in process space 12. For example, substrate holder 30 can be electrically biased at a RF voltage via the transmission of RF power from a RF generator (not shown) through an impedance match network (not shown) to substrate holder 30. The RF bias can serve to heat electrons to form and maintain plasma. In this configuration, the system can operate as a reactive ion etch (RIE) reactor, wherein the chamber and upper gas injection electrode serve as ground surfaces. A typical frequency for the RF bias can range from 1 MHz to 100 MHz and is preferably 13.56 MHz. RF systems for plasma processing are well known to those skilled in the art.

[0033] Alternately, the processing plasma formed in process space 12 can be formed using a parallel-plate, capacitively coupled plasma (CCP) source, an inductively coupled plasma (ICP) source, any combination thereof, and with and without magnet systems. Alternately, the processing plasma in process space 12 can be formed using electron cyclotron resonance (ECR). In yet another embodiment, the processing plasma in process space 12 is formed from the launching of a Helicon wave. In yet another embodiment, the processing plasma in process space 12 is formed from a propagating surface wave.

[0034] Referring now to the illustrated embodiment depicted in FIG. 2 (plan view) and FIG. 3 (cross-sectional plan view), baffle plate 64 can form a canted ring comprising an upper surface 182, a lower surface 184, an inner radial edge 186, and an outer radial edge 188. The baffle plate 64 can further comprise at least one passageway 190 coupled to the upper surface 182 and to the lower surface 184, and configured to permit the flow of gas therethrough.

[0035] FIG. 4 provides an expanded view of one of the passageways 190, wherein the expanded view provides a cross-sectional view of the passageway 190. Each passageway 190 comprises an inner passageway surface 192 contiguous with the upper surface 182 and the lower surface 184 of the baffle plate 64. For example, inner passageway surface 192 can comprise at least one flat and/or curved surfaces. Additionally, for example, at least one passageway 190 can comprise a minimum length, dictated by the distance between the upper surface 182 and the lower

surface 184 proximate each passageway 190, having a dimensional range from 1 to 50 mm. Desirably, the minimum length comprises a dimensional range from 1 to 10 mm, and preferably the minimum length is at least 2 mm.

[0036] FIG. 5 provides an exemplary cross-sectional view of baffle plate 64 depicting several passageways 190 in cross-section. In the illustrated embodiment shown in FIG. 2 and FIG. 5, the passageways 190 can comprise at least one orifice that is aligned in a radial direction. Alternately, the at least one orifice can be aligned in an azimuthal direction. In an alternate embodiment of the present invention, the at least one passageway 190 can be slanted and, therefore, aligned partially in a radial direction and an azimuthal direction. In an alternate embodiment, the at least one passageway 190 can comprise a combination of alignment methodologies thereof. Alternately, the at least passageway 190 can include at least one slot.

[0037] Referring still to FIG. 5, inner radial edge 186 comprises an inner edge surface 212 contiguous with the upper surface 182 and the lower surface 184 of baffle plate 64. For example, the inner edge surface 212 can comprise a curved and/or flat surface.

[0038] Referring still to FIG. 5, baffle plate 64 can comprise surfaces 182 and 184, wherein at least one of the upper surface 182 and the lower surface 184 is inclined at an angle 195. For example, the angle 195 of inclination for each surface can be the same as shown in FIG. 5. Additionally, for example, the angle 195 can range from 0 to 90 degrees. Desirably, the angle 195 ranges from 0 to 60 degrees; and preferably, the angle 195 ranges from 0 to 45 degrees.

[0039] FIG. 6. illustrates an expanded cross sectional view of the outer radial edge 188 of baffle plate 64. As depicted in FIG. 6 and FIG. 2, baffle plate 64 can, for example, further comprise a plurality of fastening receptors 200, each fastening receptor 200 can be coupled to the upper surface 182 and the lower surface 184, and configured to receive fastening devices (not shown) (such as bolts) to couple baffle plate 64 to the plasma processing system 1. The fastening receptors 200 can comprise an entrant cavity 202, an exit through-hole 204, and an inner receptor surface 206. For example, the number of fastening receptors 200 formed within baffle plate 64 can range from 0 to 100. Desirably, the number of fastening receptors 200 can range from 5 to 20; and, preferably, the number of fastening receptors 200 equals 8.

[0040] Referring still to FIG. 6, the outer radial edge 188 can further comprise an outer edge surface 214, a first mating surface 216, and a second mating surface 218. The outer edge surface 214 can be coupled to the upper surface 182 and the lower surface 184 of baffle plate 64. Upper surface 182 can comprise the first mating surface 216 that can be configured to mate with plasma processing system 1. Lower surface 184 can comprise the second mating surface 218 that can be configured to mate with plasma processing system 1. Additionally, for example, the outer radial edge 188 can comprise a thickness, dictated by the distance between the first mating surface 216 and the second mating surface 218 proximate the outer edge surface 214, having a dimensional range from 1 to 50 mm. Desirably, the thickness comprises a dimensional range from 1 to 10 mm, and preferably the thickness is at least 5 mm.

[0041] Referring now to FIGs. 2 through 6, the baffle plate 64 further comprises a protective barrier 150 formed on a plurality of exposed surfaces 220 of the baffle plate 64. In an embodiment of the present invention, the exposed surfaces 220 can comprise the upper surface 182 of baffle plate 64 excluding the first mating surface 216; the lower surface 184 of baffle plate 64 excluding the second mating surface 218; the inner edge surface 212; and the inner passageway surface 192 coupled to the upper surface 182 and the lower surface 184. In one embodiment, the entrant cavity 202 surfaces and the through-hole surfaces are exposed surfaces. Alternately, one or more of these surfaces can comprise a protective barrier. Alternately, the exposed surfaces comprise all surfaces on the baffle plate 64.

[0042] In an embodiment of the present invention, the protective barrier 150 can comprise a compound including an oxide of aluminum such as Al_2O_3. In another embodiment of the present invention, the protective barrier 150 can comprise a mixture of Al_2O_3 and Y_2O_3. In another embodiment of the present invention, the protective barrier 150 can comprise at least one of a III-column element (column III of periodic table) and a Lanthanon element. In another embodiment of the present invention, the III-column element can comprise at least one of Yttrium, Scandium, and Lanthanum. In another embodiment of the present invention, the Lanthanon element can comprise at least one of Cerium, Dysprosium, and Europium. In another embodiment of the present invention, the compound forming protective barrier 150 can comprise at least one of Yttria (Y_2O_3), Sc_2O_3, Sc_2F_3, YF_3, La_2O_3, CeO_2, Eu_2O_3, and DyO_3.

[0043] In an embodiment of the present invention, the protective barrier 150 formed on baffle plate 64 comprises a thermal sprayed coating having a minimum thickness, wherein the minimum thickness can be allowed to vary across the plurality of exposed surfaces 220. In other words, the specified thickness can be variable across the exposed surfaces 220. For example, the minimum thickness can be constant over a first portion of the exposed surfaces 220 and variable over a second portion of the exposed surfaces 220. For example, a variable thickness can occur on a curved surface, on a corner, or in a hole. The minimum thickness ranges from 0 micron to 550 micron. Desirably, the minimum thickness ranges from 50 micron to 250 micron; and, preferably, the minimum thickness ranges from 150 micron to 250 micron.

[0044] Additionally, as shown in FIG. 2, baffle plate 64 can, for example, further comprise a plurality of mounting through-holes 201. Each mounting through-hole 201 can be coupled to the upper surface 182 and the lower surface 184, and configured to receive fastening devices (not shown) (such as bolts) to couple baffle plate 64 to at least one of the plasma processing chamber 10 and the deposition shield 14. For example, the number of mounting through-holes 201 formed within baffle plate 64 can range from 0 to 100. Desirably, the number of mounting through-holes 201 ranges from 5 to 20; and, preferably, the number of mounting through-holes 201 is at least 10.

[0045] FIG. 7 presents a method of producing the baffle plate 64 in the plasma processing system described in FIG. 1 according to an embodiment of the present invention. A flow diagram 300 begins in 310 with fabricating the baffle plate 64 (e.g., a baffle plate having the characteristics of the plate described with reference to FIGs. 2-6). Fabricating the baffle plate can comprise at least one of machining, casting, polishing, forging, and grinding. For example, each of the elements described above can be machined according to specifications set forth on a mechanical drawing, using conventional techniques including a mill, a lathe, etc. The techniques for machining a component using, for example, a mill or a lathe, are well known to those skilled in the art of machining. The baffle plate can, for example, be fabricated from aluminum.

[0046] In 320, the baffle plate is anodized to form a surface anodization layer. For example, when fabricating the baffle plate from aluminum, the surface anodization

layer comprises aluminum oxide (Al_2O_3). Methods of anodizing aluminum components are well known to those skilled in the art of surface anodization.

[0047] In 330, the surface anodization layer is removed from the exposed surfaces 220 using standard machining techniques. During the same machining step, or during a separate machining step, other surfaces (e.g., the first mating surface of the upper surface, and the second mating surface of the lower surface) may also be machined (e.g., to produce a flat or bare surface that provides at least one of a good mechanical or electrical contact at the machined surface).

[0048] In 340, the protective barrier 150 is formed on the exposed surfaces 220. A protective barrier 150 comprising, for example Yttria, can be formed using (thermal) spray coating techniques that are well known to those skilled in the art of ceramic spray coatings. In an alternate embodiment, forming the protective barrier can further comprise polishing the thermal spray coating. For example, polishing the thermal spray coating can comprise the application of sand paper to the sprayed surfaces.

[0049] FIG. 8 presents a method of producing the baffle plate in the plasma processing system described in FIG. 1 according to another embodiment of the present invention. A flow diagram 400 begins in 410 with fabricating the baffle plate 64 (e.g., a baffle plate having the characteristics of the plate described with reference to FIGs. 2-6). Fabricating the baffle plate can comprise at least one of machining, casting, polishing, forging, and grinding. For example, each of the elements described above can be machined according to specifications set forth on a mechanical drawing, using conventional techniques including a mill, a lathe, etc. The techniques for machining a component using, for example, a mill or a lathe, are well known to those skilled in the art of machining. The baffle plate can, for example, be fabricated from aluminum.

[0050] In 420, exposed surfaces 220 are masked to prevent the formation of a surface anodization layer thereon. Techniques for surface masking and unmasking are well known to those skilled in the art of surface coatings and surface anodization. During the same masking step, or during a separate masking step, other surfaces (e.g., the first mating surface of the upper surface, and the second mating surface of the lower surface) may also be masked (e.g., to maintain a flat or bare surface that provides at least one of a good mechanical or electrical contact at the machined surface).

[0051] In 430, the baffle plate is anodized to form a surface anodization layer on the remaining unmasked surfaces. For example, when fabricating the baffle plate from aluminum, the surface anodization layer can comprise aluminum oxide (Al_2O_3). Methods of anodizing aluminum components are well known to those skilled in the art of surface anodization.

[0052] In 440, the exposed surfaces 220 are unmasked, and the protective barrier 150 is formed on the exposed surfaces 220. A protective barrier comprising, for example Yttria, can be formed using (thermal) spray coating techniques that are well known to those skilled in the art of ceramic spray coatings. In an alternate embodiment, forming the protective barrier can further comprise polishing the thermal spray coating. For example, polishing the thermal spray coating can comprise the application of sand paper to the sprayed surfaces.

[0053] FIG. 9 presents a method of producing the baffle plate in the plasma processing system described in FIG. 1 according to another embodiment of the present invention. A flow diagram 500 begins in 510 with fabricating the baffle plate 64 (e.g., a baffle plate having the characteristics of the plate described with reference to FIGs. 2-6). Fabricating the baffle plate can comprise at least one of machining, casting, polishing, forging, and grinding. For example, each of the elements described above can be machined according to specifications set forth on a mechanical drawing, using conventional techniques including a mill, a lathe, etc. The techniques for machining a component using, for example, a mill or a lathe, are well known to those skilled in the art of machining. The baffle plate can, for example, be fabricated from aluminum.

[0054] In 520, a protective barrier 150 is formed on exposed surfaces 220 of the baffle plate 64. A protective barrier comprising, for example Yttria, can be formed using (thermal) spray coating techniques that are well known to those skilled in the art of ceramic spray coatings. In an alternate embodiment, forming the protective barrier can further comprise polishing the thermal spray coating. For example, polishing the thermal spray coating can comprise the application of sand paper to the sprayed surfaces.

[0055] The processes of forming a protective barrier 150 on the exposed surfaces 220, described with reference to FIGs. 7-9 can be modified to utilize a combination of machining and masking. In such a modified process, at least one exposed surface is masked to prevent formation of the anodization layer thereon while other exposed

surfaces are anodized. The exposed surfaces that are unmasked are then machined, and the exposed surfaces that were masked are unmasked. The protective barrier 150 can then be formed on all the exposed surfaces. As described above, additional surfaces that are not exposed surfaces may also be machined during the method (e.g., in order to provide a better mechanical or electrical contact than would be formed with the anodization layer thereon.

[0056] Although only certain exemplary embodiments of this invention have been described in detail above, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention.

CLAIMS:

What is claimed is:

1. An improved baffle plate in a plasma processing system comprising:

a canted ring comprising an upper surface, a lower surface, an inner radial edge coupled to said upper surface and said lower surface, an outer radial edge coupled to said upper surface and said lower surface, and at least one passageway coupled to said upper surface and to said lower surface and configured to permit the flow of a gas therethrough, wherein said upper surface comprises a first mating surface proximate said outer radial edge, said lower surface comprises a second mating surface proximate said outer radial edge, said inner radial edge comprises an inner edge surface, and each of said at least one passageway comprises an internal passageway surface; and

a protective barrier coupled to a plurality of exposed surfaces of said baffle plate, wherein said exposed surfaces comprise said upper surface excluding said first mating surface, said lower surface excluding said second mating surface, said inner edge surface of said inner radial edge, and said internal passageway surface of each of said at least one passageway.

2. The improved baffle plate as recited in claim 1, wherein at least one passageway comprises a slot.

3. The improved baffle plate as recited in claim 2, wherein said slot comprises an entrance area and an exit area, wherein said entrance area is larger than said exit area.

4. The improved baffle plate as recited in claim 1, wherein at least one passageway comprises an orifice.

5. The improved baffle plate as recited in claim 1, wherein said canted ring further comprises a plurality of fastening receptors and a plurality of mounting through-holes coupled to said upper surface and said lower surface of said baffle plate and configured to receive fastening devices in order to couple said baffle plate to said plasma processing system.

6. The improved baffle plate as recited in claim 5, wherein each of said plurality of fastening receptors comprises an entrant cavity, an exit through-hole, and an inner receptor surface.

7. The improved baffle plate as recited in claim 1, wherein said baffle plate comprises a metal.

8. The improved baffle plate as recited in claim 1, wherein said metal comprises aluminum.

9. The improved baffle plate as recited in claim 1, wherein said protective barrier comprises a compound containing at least one of a III-column element and a Lanthanon element.

10. The improved baffle plate as recited in claim 9, wherein said III-column element comprises at least one of Yttrium, Scandium, and Lanthanum.

11. The improved baffle plate as recited in claim 9, wherein said Lanthanon element comprises at least one of Cerium, Dysprosium, and Europium.

12. The improved baffle plate as recited in claim 1, wherein said protective barrier comprises at least one of Yttria (Y_2O_3), Sc_2O_3, Sc_2F_3, YF_3, La_2O_3, CeO_2, Eu_2O_3, and DyO_3.

13. The improved baffle plate as recited in claim 1, wherein said protective barrier comprises a minimum thickness and said minimum thickness is constant across at least one of said exposed surfaces.

14. The improved baffle plate as recited in claim 1, wherein said protective barrier comprises a minimum thickness and said minimum thickness is variable across at least one of said exposed surfaces.

15. The improved baffle plate as recited in claim 1, wherein at least one of said upper surface and said lower surface is inclined at an angle.

16. The improved baffle plate as recited in claim 15, wherein a range of said angle comprises 0 to 60 degrees.

17. A method of producing an improved baffle plate of a plasma processing system, said method comprising the steps:

fabricating said baffle plate, said baffle plate comprising a canted ring having an upper surface, a lower surface, an inner radial edge, an outer radial edge, and at least one passageway coupled to said upper surface and to said lower surface and configured to permit the flow of a gas therethrough, wherein said upper surface comprises a first mating surface proximate said outer radial edge, said lower surface comprises a second mating surface proximate said outer radial edge, said inner radial edge comprises an inner edge surface, and each of said at least one passageway comprises an internal passageway surface; and

forming a protective barrier on exposed surfaces, said exposed surfaces comprising said upper surface excluding said first mating surface, said lower surface excluding said second mating surface, said inner edge surface of said inner radial edge, and said internal passageway surface of each of said at least one passageway.

18. The method as recited in claim 17, wherein said method further comprises the steps:

anodizing said baffle plate to form a surface anodization layer on said baffle plate; and

machining said exposed surfaces on said baffle plate to remove said surface anodization layer.

19. The method as recited in claim 17, wherein said method further comprises the steps:

masking said exposed surfaces to prevent formation of a surface anodization layer;

anodizing said baffle plate to form a surface anodization layer on said baffle plate; and

unmasking said exposed surfaces on said baffle plate.

20. The method as recited in claim 17, wherein said baffle plate comprises a metal.

21. The method as recited in claim 20, wherein said metal comprises aluminum.

22. The method as recited in claim 17, wherein said protective barrier comprises a compound containing at least one of a III-column element and a Lanthanon element.

23 The method as recited in claim 22, wherein said III-column element comprises at least one of Yttrium, Scandium, and Lanthanum.

24. The method as recited in claim 22, wherein said Lanthanon element comprises at least one of Cerium, Dysprosium, and Europium.

25. The method as recited in claim 17, wherein said protective barrier comprises at least one of Yttria (Y_2O_3), Sc_2O_3, Sc_2F_3, YF_3, La_2O_3, CeO_2, Eu_2O_3, and DyO_3.

26. The method as recited in claim 17, wherein said protective barrier comprises a minimum thickness and said minimum thickness is constant across at least one of said exposed surfaces.

27. The method as recited in claim 17, wherein said protective barrier comprises a minimum thickness and said minimum thickness is variable across at least one of said exposed surfaces.

28. The method as recited in claim 17, wherein said fabricating comprises at least one of machining, casting, polishing, forging, and grinding.

29. The method as recited in claim 17, wherein said forming a protective barrier further comprises polishing the protective barrier on at least one of said plurality of exposed surfaces.

30. The method as recited in claim 17, wherein at least one passageway comprises a slot.

31. The method as recited in claim 30, wherein said slot comprises an entrance area and an exit area, wherein said entrance area is larger than said exit area.

32. The method as recited in claim 17, wherein at least one passageway comprises an orifice.

33. The method as recited in claim 17, wherein said baffle plate further comprises a plurality of fastening receptors and a plurality of mounting through-holes coupled to said upper surface and said lower surface of said baffle plate and configured to receive fastening devices in order to couple said baffle plate to said plasma processing system.

34. The method as recited in claim 33, wherein each of said plurality of fastening receptors comprises an entrant cavity, an exit through-hole, and an inner receptor surface.

35. The method as recited in claim 17, wherein said exposed surfaces further comprise at least one of said first mating surface, said second mating surface, and said outer edge surface.

36. The method as recited in claim 17, wherein at least one of said upper surface and said lower surface is inclined at an angle.

37. The method as recited in claim 36, wherein a range of said angle comprises 0 to 60 degrees.

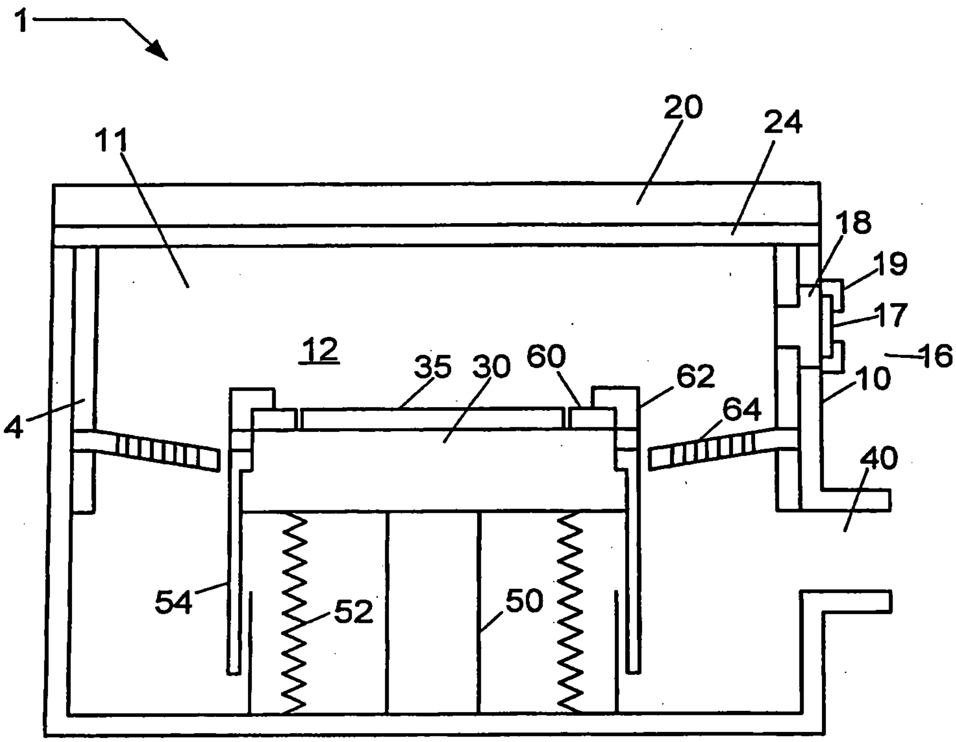


FIG. 1.

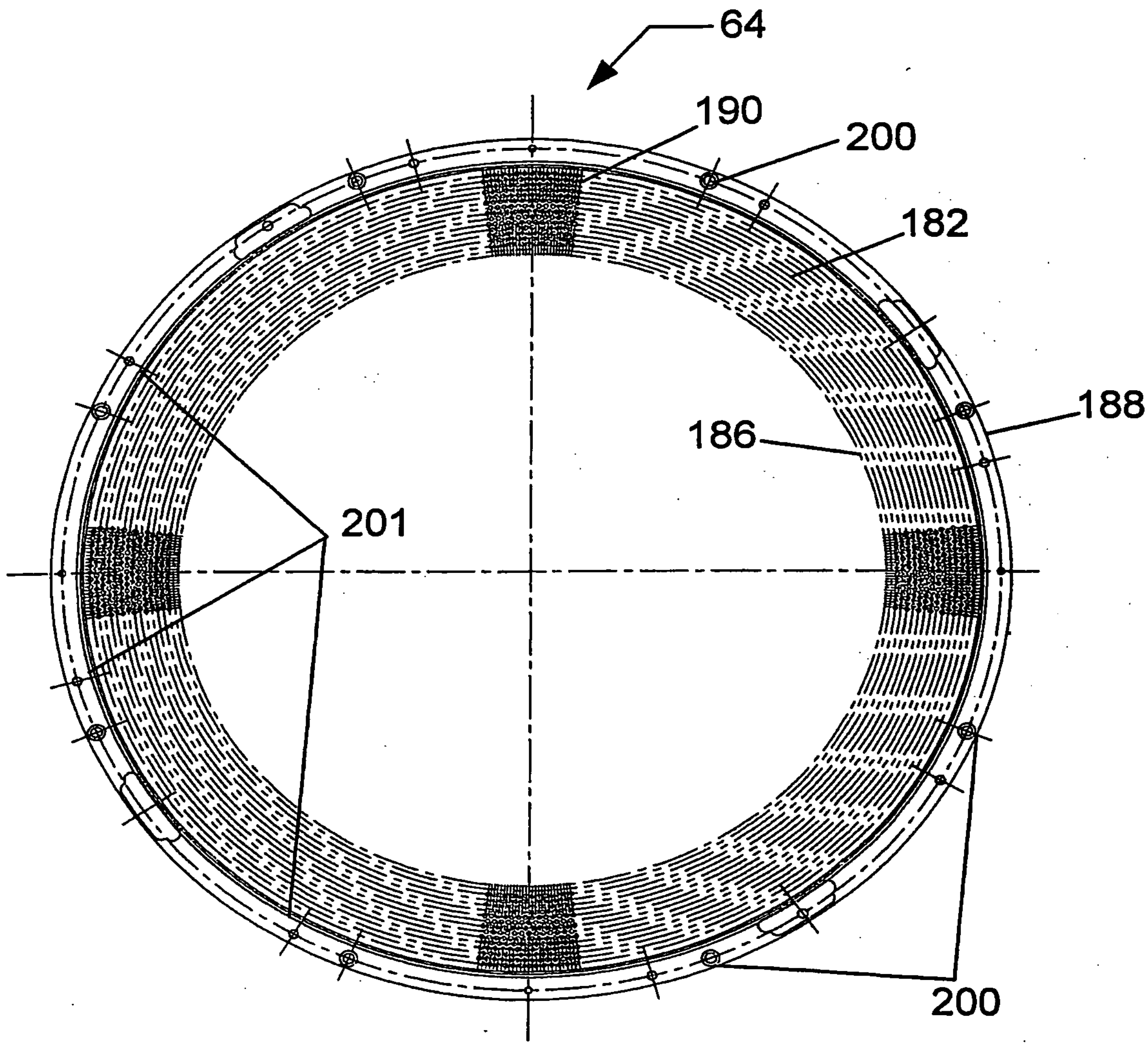


FIG. 2.

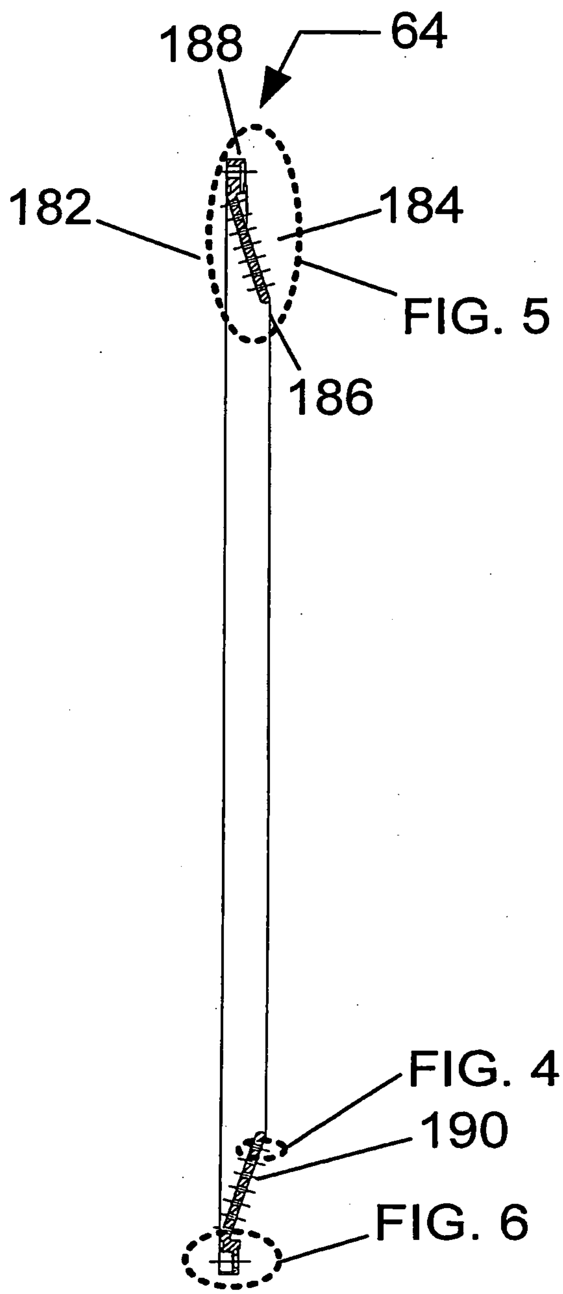


FIG. 3.

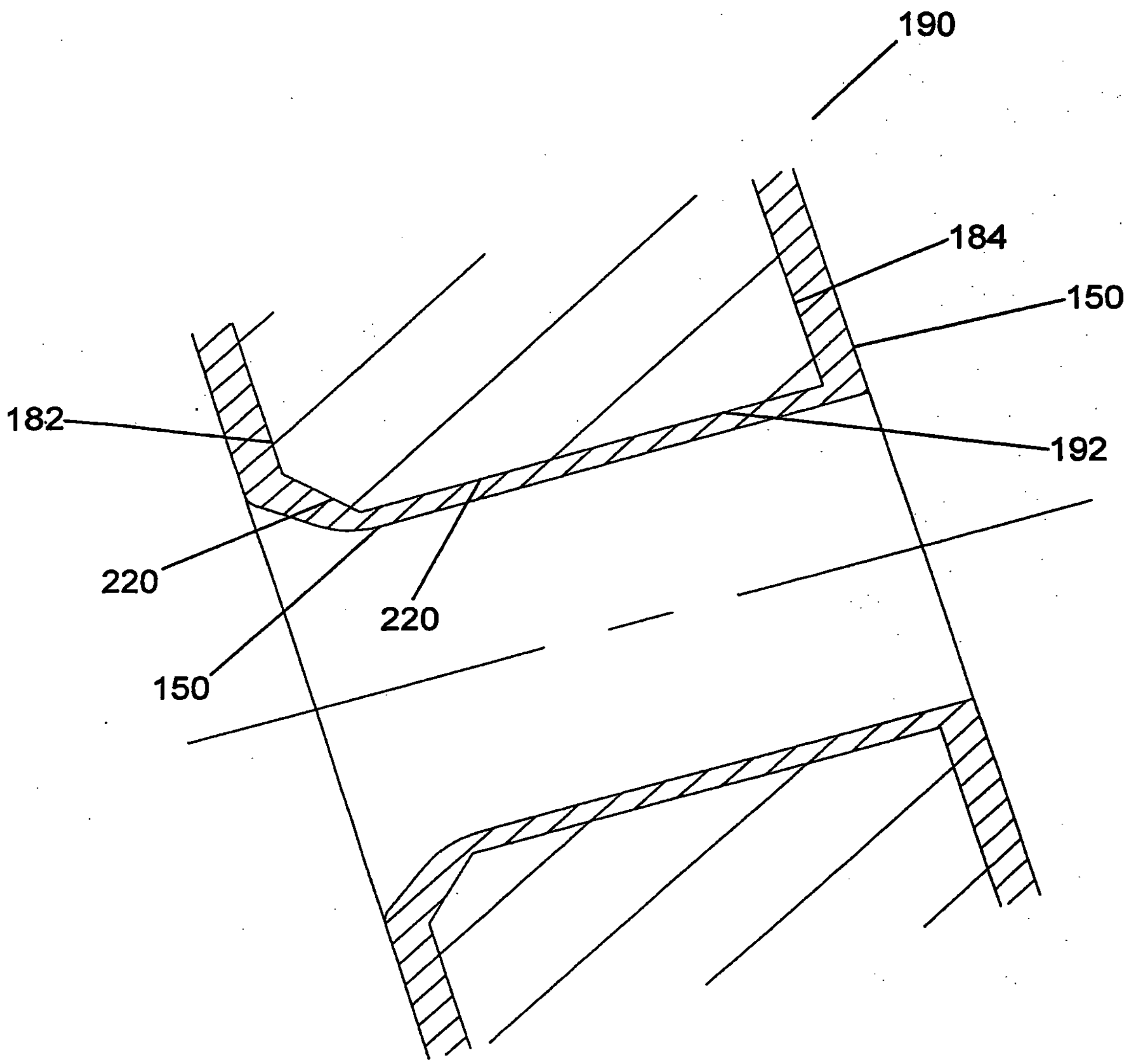


FIG. 4.

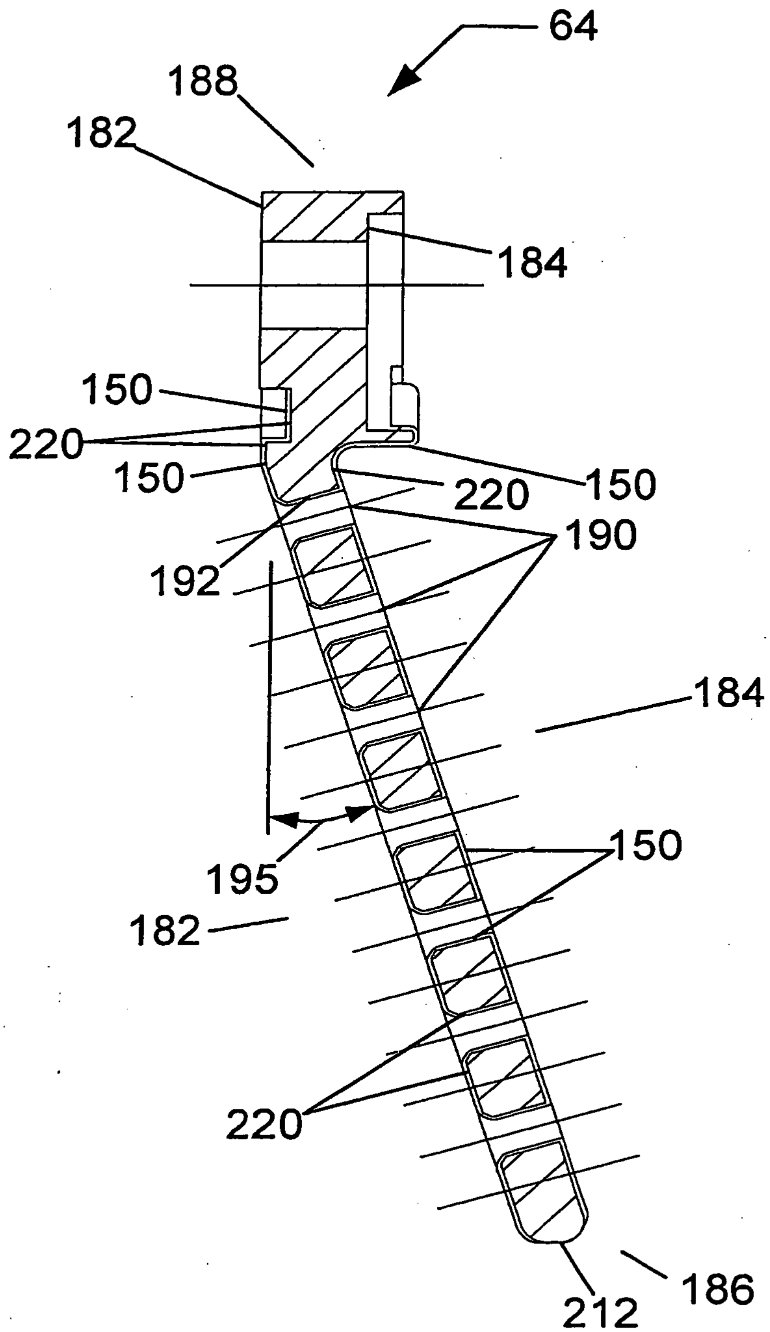

64
188
182
184
150
220
150
150
220
190
192
184
195
150
182
220
212
186

FIG. 5.

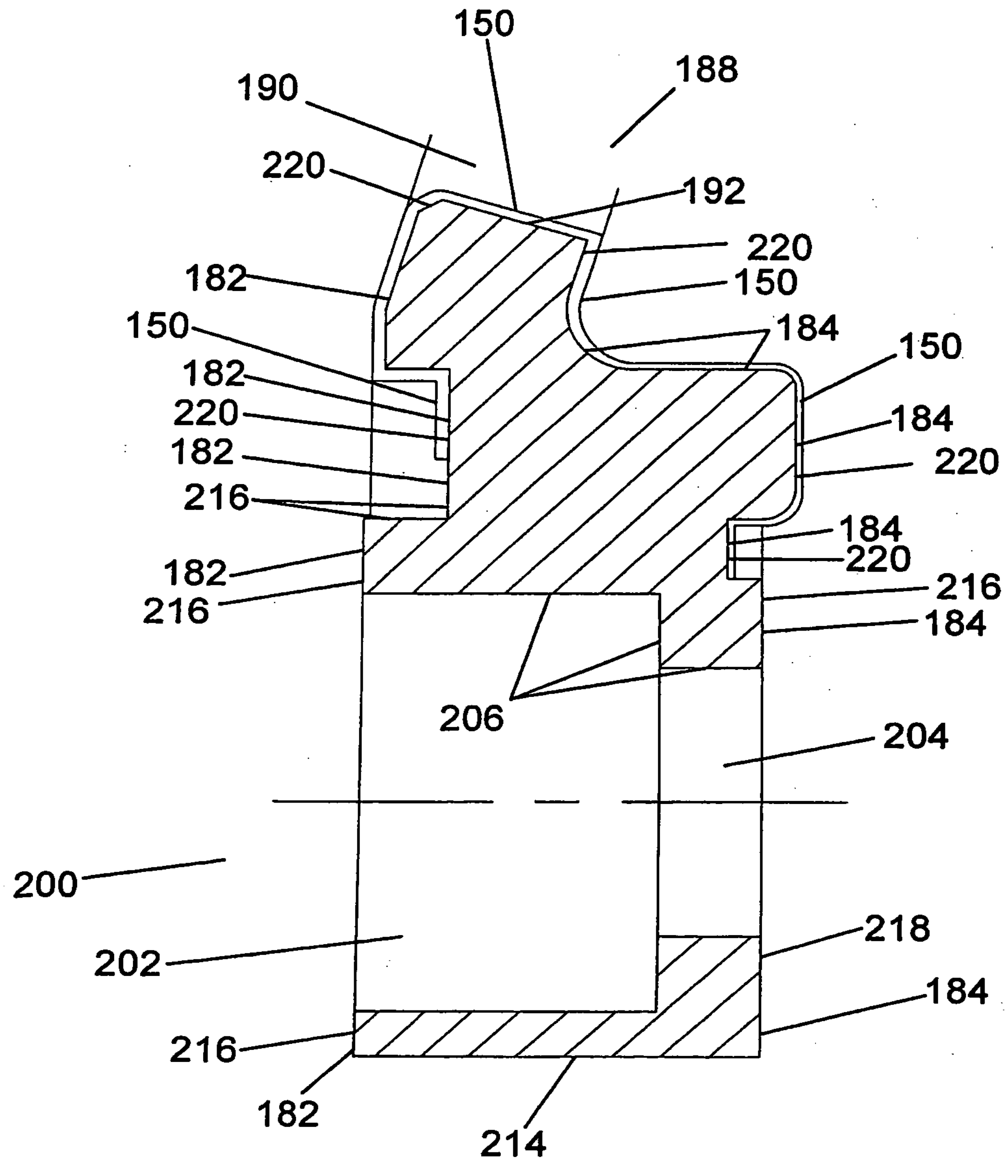

150
190
188
220
192
220
182
150
150
184
182
150
220
184
182
220
216
184
182
220
216
216
184
206
204
200
218
202
184
216
182
214

FIG. 6.

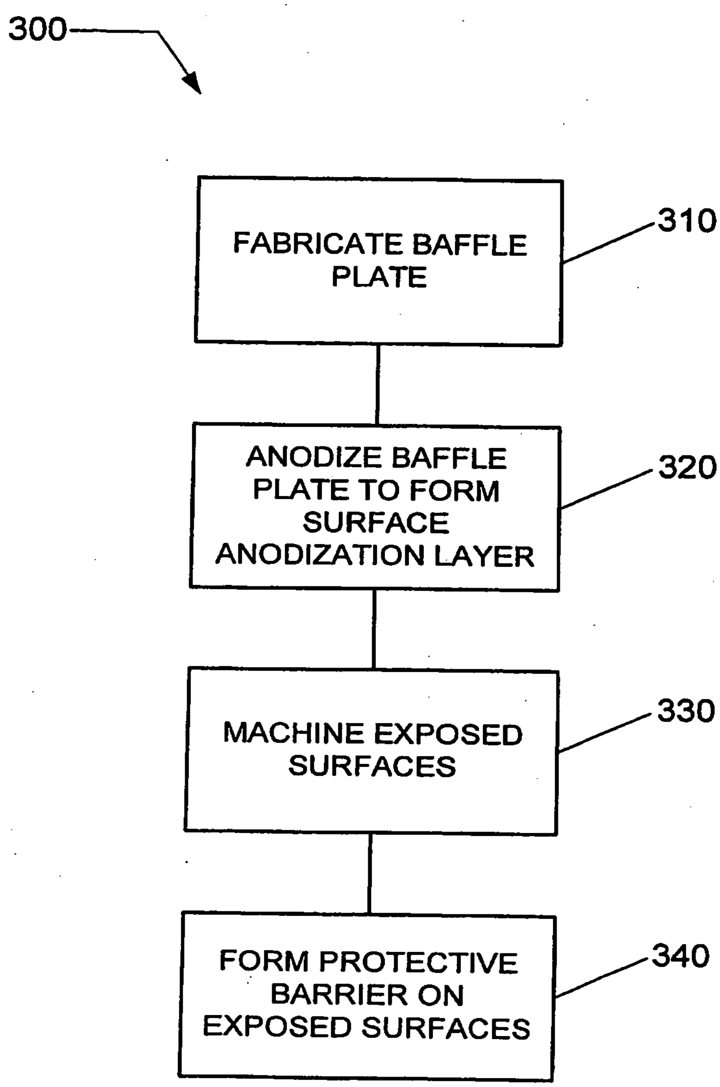

300
FABRICATE BAFFLE PLATE
310
ANODIZE BAFFLE PLATE TO FORM SURFACE ANODIZATION LAYER
320
MACHINE EXPOSED SURFACES
330
FORM PROTECTIVE BARRIER ON EXPOSED SURFACES
340

FIG. 7.

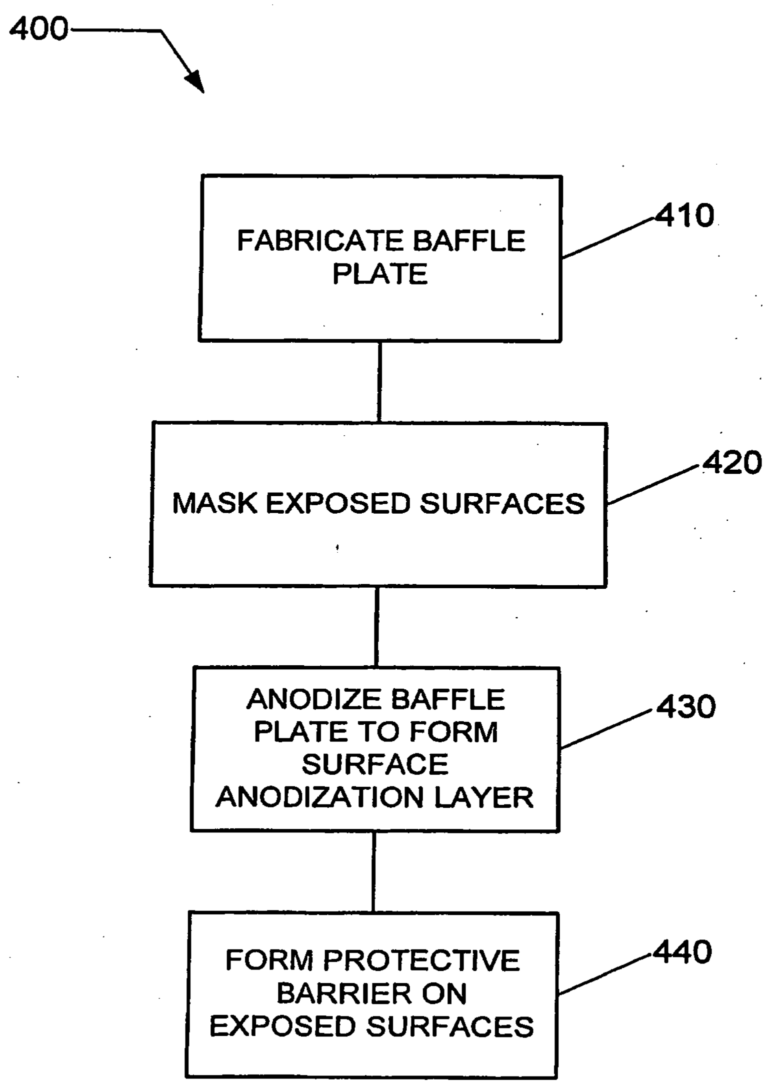

400
FABRICATE BAFFLE PLATE
410
MASK EXPOSED SURFACES
420
ANODIZE BAFFLE PLATE TO FORM SURFACE ANODIZATION LAYER
430
FORM PROTECTIVE BARRIER ON EXPOSED SURFACES
440

FIG. 8.

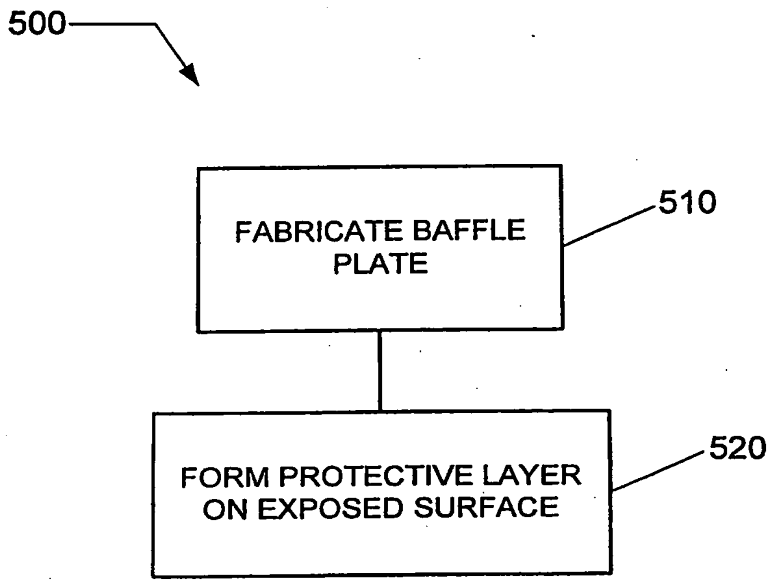

500
FABRICATE BAFFLE PLATE
510
FORM PROTECTIVE LAYER ON EXPOSED SURFACE
520

FIG. 9.